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(54) Display device with terminals connected to a folded film substrate

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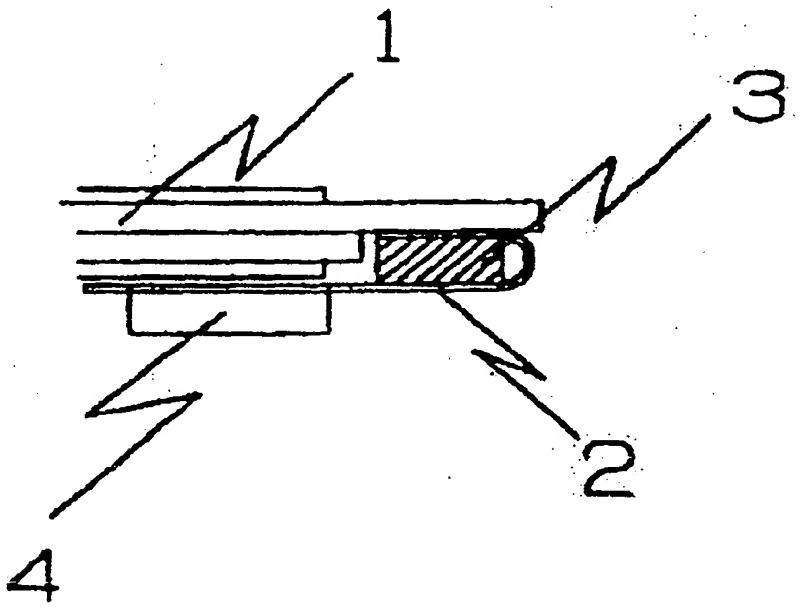

Fig. 1

EP 0 911 678 A2

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Description

[0001] The present invention relates to a display device for use in portable equipment, such as an electronic memo device and the like which uses an implement such as pen as an input means.

[0002] Fig. 5 shows a schematic structure of a conventional display device. As shown in Fig. 5, in a mounting structure of a conventional display device, a film substrate TCP (Tape Carrier Package) 8 provided with a slit for folding is used, and the terminals of a display element 1 are connected with the terminals of the TCP 8. An IC 4 is mounted on the TCP and further the TCP is connected with a circuit substrate such that fabrication is carried out with the TCP folded over and with the circuit substrate located on the rear surface of the display element. As the circuit substrate, a glass epoxy substrate, a polyimide film substrate or the like with chip parts mounted thereon has been used.

[0003] Fig. 6 shows a schematic view of a COF (Chip On FPC) structure with the IC 4 directly mounted on the film substrate 2. In a COF structure, the above-mentioned TCP circuit and the circuit of the circuit substrate are formed on a single film substrate.

[0004] However, in the structure shown in Fig. 5, since the TCP 8 is provided with a slit for folding of the TCP, and the folding is carried out after the TCP 8 is connected in a flat state with the terminals of the display element 1 by thermocompression bonding, there is a problem that a margin 9 for folding over the TCP goes beyond the outer shape of the display device, resulting in larger overall size of the device.

[0005] Further, depending on the direction of the folding, the IC 4 and other electronic parts mounted on the film substrate are located between the film substrate and the display element. In that case, restriction with regard to the thickness of the whole film substrate increases in designing electronic equipment in which the display element is to be incorporated.

[0006] In the COF structure shown in Fig. 6, though the problem of parts location can be dealt with by a through hole; since the number of output electrodes of the driver IC 4 is large and the terminal connection pitch is fine, a through hole area 10 increases in size. This either decreases the parts mounted area or enlarges the outer shape of the film substrate, leading to increased design restriction.

[0007] In the case where the connection between terminals of the film substrate and of the display element is structured as shown in Fig. 7, there arises design restrictions with regard to a margin for folding over the film 2 and with regard to the through hole area.

[0008] In the case where a COF formed of a single film substrate is connected with a display element whose terminals are disposed on respective transparent substrates facing each other, connection with one of the transparent substrates can be carried out, while connection with the other, facing transparent substrate is very difficult in a compression bonding process. Therefore in this case, the COF must be prepared for the terminals of the respective transparent substrates forming the display element.

[0009] Further though an I/F cable may be connected with a circuit substrate as a discrete part, in the case of a COF, the I/F cable is formed of an FPC itself so as to be T-shaped or L-shaped. Because of the shape, the number of the COFs which can be taken from the material is small.

[0010] Accordingly, objects of the present invention are to make smaller the size of the outer shape of a margin portion for folding over a film substrate, to realise a structure where a single film substrate can be easily connected with a plurality of sides of a display element, and to make larger the number of film substrates which can be taken from the material by improving the layout of I/F cables.

[0011] In order to solve these problems, a display device according to the present invention is structured such that the tip of terminals of a film substrate to be connected with a display element is held folded down with a spacer sandwiched therebetween, the film substrate in this state is disposed on the inner shape side of the display element, and the terminals of the film substrate are connected with the terminals of the display element.

[0012] Further, in the case that a display element having terminals on its plurality of sides is used, the terminals are disposed on the respective sides on one of the transparent substrates and the terminals of the film substrate are connected with the terminals on the respective sides.

[0013] Still further, an I/F cable is formed by making a U-shaped cut in the film substrate.

[0014] Since the film substrate in a folded state is disposed on the inner shape side of the display element and the terminals of the film substrate are connected with the terminals of the display element, the margin for folding over the film substrate does not go beyond the outer shape of the display element, or, the amount of the margin for folding over the film substrate going beyond the outer shape of the display element is decreased, and thus, the outer shape of the display device can be made smaller.

[0015] Further, restriction with regard to the parts mounting area and the wiring layout can be eliminated and the surface of parts such as an IC can be located on the front surface.

[0016] In the case of a display element having terminals on its plurality of sides, since the terminals are provided on a plurality of adjacent sides of one of transparent substrates forming the display element, a single film substrate can be connected with the terminals on the plurality of sides, and thus, the number of parts can be reduced.

[0017] Further, since the I/F cable is formed by making a U-shaped cut in the film substrate, the number of

film substrates which can be taken from the material becomes larger

[0018] Embodiments of the present invention will now be described by way of further example only and with reference to the accompanying drawings, in which:-

Fig. 1 is a side elevation showing a schematic structure of a display device according to the present invention,

Fig. 2 is a side view showing a film substrate for use in the display device according to the present invention.

Fig. 3 is a perspective view showing a rear surface of a display device of a second embodiment according to the present invention,

Fig. 4 is a perspective view showing a rear surface of a liquid crystal display element of the second embodiment according to the present invention,

Fig. 5 is a side view showing a schematic structure of a conventional display device,

Fig. 6 is a side view showing a schematic structure of a conventional COF type display device, and

Fig. 7 is a side view showing a schematic structure of a conventional COF type display device with a folded-over portion.

(Embodiment 1)

[0019] Fig. 1 is a side elevation showing a schematic structure of a display device according to the present invention. A display element 1 has glass substrates with a thickness of 0.5 mm and has transparent electrodes such as ITO electrodes formed thereon, facing each other with the patterned faces being on the inner sides of the substrates. A liquid crystal is encapsulated in the space between the glass substrates and a polarising plate is provided. Fig. 2 is a side view showing the state of a film substrate just before being mounted on the display element. A driver IC 4 is face down mounted with an anisotropic conductive film on a film substrate 2 formed by patterning Cu on a polyimide film having a thickness of 25 microns. Output signal electrodes of the drive IC are led to terminals for connection with the display element, and are in the state of being folded over with a spacer 3, made of silicon and having a Shore A hardness of about 70, sandwiched with adhesive therebetween.

[0020] The terminals of the film substrate and of the display element are thermocompression bonded via the anisotropic conductive film to carry out connection. Though thermocompression bonding is typically carried out from the side of the film substrate, in the illustrated arrangement it is carried out from the side of the glass surface. Compression bonding for 20 seconds with the temperature of a compression bonding head being set at 250°C and reaching a temperature of about 180°C is sufficient to carry out curing reliably

[0021] The size of the outer shape of the display device according to the embodiment shown in Fig. 1 can be made smaller than that of a conventional structure by about 1.5 mm. However, the present invention is not limited to a structure in which a margin for folding over a film substrate is located inside the outer shape of the terminals of a display device. There is no particular problem even if the margin for folding over the film substrate goes beyond the outer shape of the device.

[0022] Treatment of the terminals of the film substrate is not limited to folding them over with a spacer sandwiched therebetween. They may be wound or may have any other structure which functions similarly to that of the present embodiment. The material of the spacer is selected according to the temperature and the conditions at which the spacer is compression bonded against the liquid crystal display device and so on

[0023] The size of the film substrate is not limited to the above-mentioned one. Further, a TCP may also be used.

[0024] Still further, the film substrate may be made of PET. In this case, since PET is permeable to ultraviolet light, the film substrate may be directly connected with the IC using ultraviolet-light-curing contractive adhesive. Similarly, the display element and the film substrate may be directly connected with each other using ultraviolet-light-curing contractive adhesive. Also, in this case, when the connection is carried out via a conductor such as Ag, the reliability is further improved.

[0025] The connection between the terminals of the film substrate and of the liquid crystal display device may be carried out by pressure welding using a caulking metal frame without using the anisotropic conductive film or the ultraviolet-light-curing adhesive. In this case, replacement of the film substrate becomes easier.

(Embodiment 2)

[0026] Fig. 3 is a perspective view of a second embodiment of the display device according to the present invention. Fig. 4 shows a display element 1 used in the second embodiment and is a perspective view seen from the rear side. Here, description is made of an STN type liquid crystal display element being used as the display element, by way of example. Electrodes of an upper transparent substrate, shown in Fig. 4, are connected with a terminal pattern provided on the side of a lower transparent substrate using a conductive agent disposed in the liquid crystal panel. Therefore, all terminals to be externally connected are provided on the lower transparent substrate.

[0027] A film substrate 2 (Fig. 3) is a double-sided wiring board and is formed by patterning Cu on both sides of a polyimide base having a thickness of 25 microns. It is provided with a through hole. In addition to a driver IC 4, an IC package 5 and chip parts 6 are connected with the film substrate 2 by soldering or the like

[0028] The film substrate 2 and the display element 1 are connected in a similar way as in the first embodi-

ment, and the connection is carried out with regard to the respective sides one by one in order

[0029] Further, an I/F cable is formed by a part of the film substrate by making an L-shaped cut 7. Thus, the number of film substrates which can be taken from the material can be made larger.

[0030] In the case of a PET substrate being used, in order to mount thereon the IC package and the chip parts, by using Ag paste or Bi/Sn series soldering as the material, connection at 150°C or lower can be carried out to avoid deformation.

[0031] As described above, according to the present invention, a miniaturised, compact display device can be provided. Further, in the case of a film substrate being mounted on a plurality of sides of a liquid crystal display element, by reducing the number of parts, in addition to the above-mentioned effect, an inexpensive display device can be provided.

Claims

1. A display device having a pair of transparent substrates and a liquid crystal material held therebetween with terminals of a display element being connected with a terminal portion of a film substrate, characterised in that said film substrate is located on said display element and that said terminal portion of said film substrate is folded over with a spacer sandwiched therebetween for connection with said terminals of said display element.

2. A display device as claimed in claim 1, characterised in that said terminals of said display element are disposed on a plurality of sides of one of said transparent substrates and that said terminal portion of said film substrate is connected with said plurality of sides.

3. A display device as claimed in claim 1, characterised in that an I/F terminal is formed by making a cut in said film substrate.

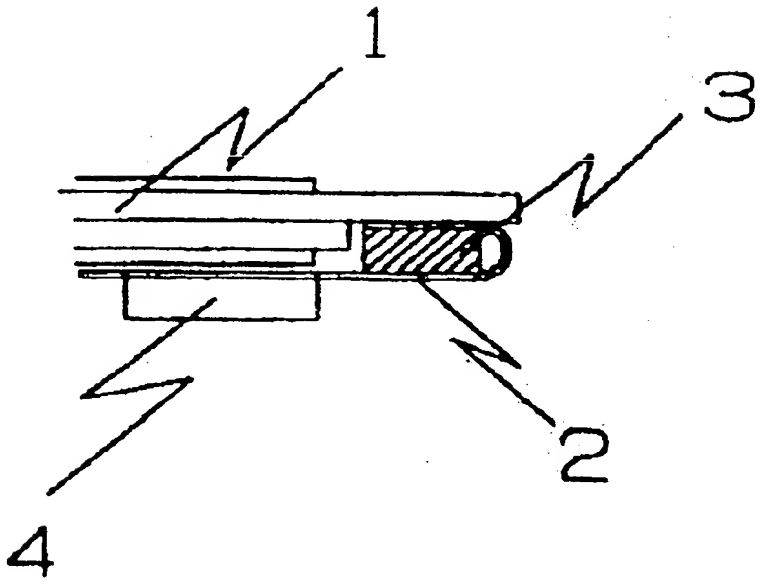


Fig. 1

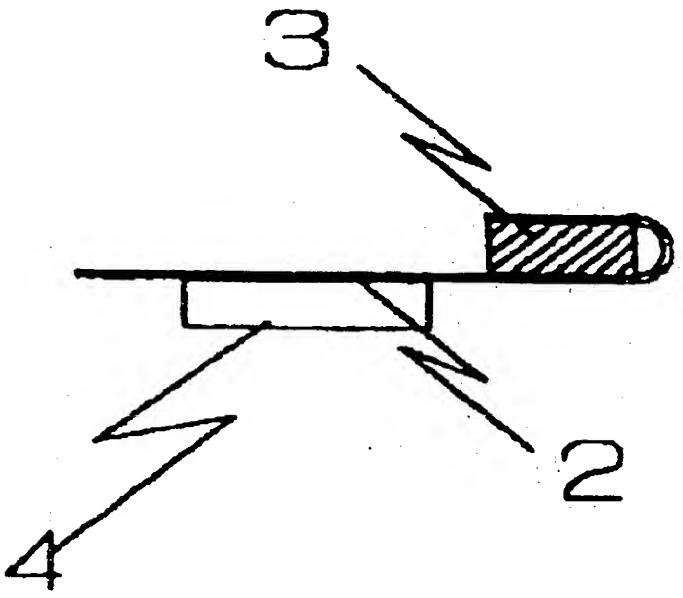


Fig. 2

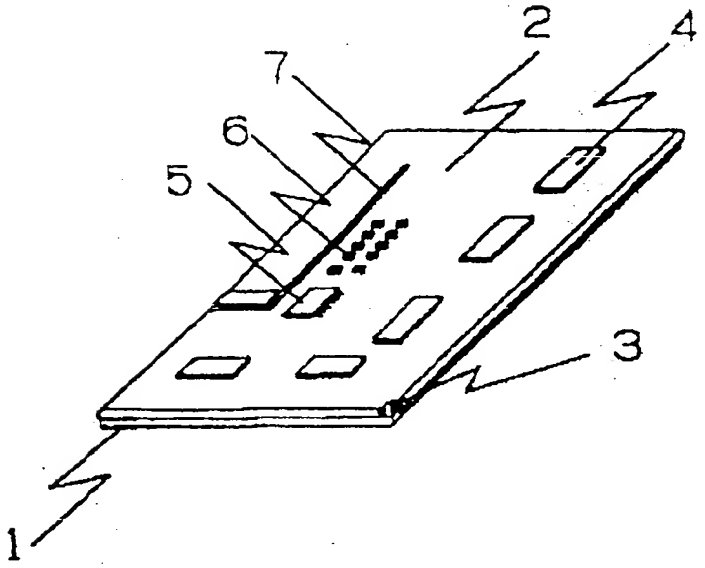


Fig. 3

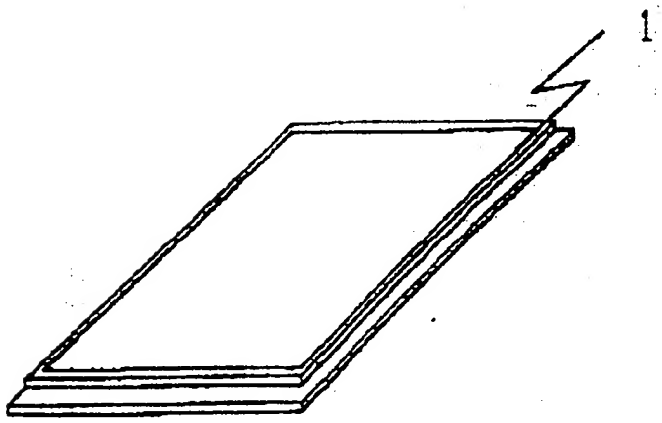
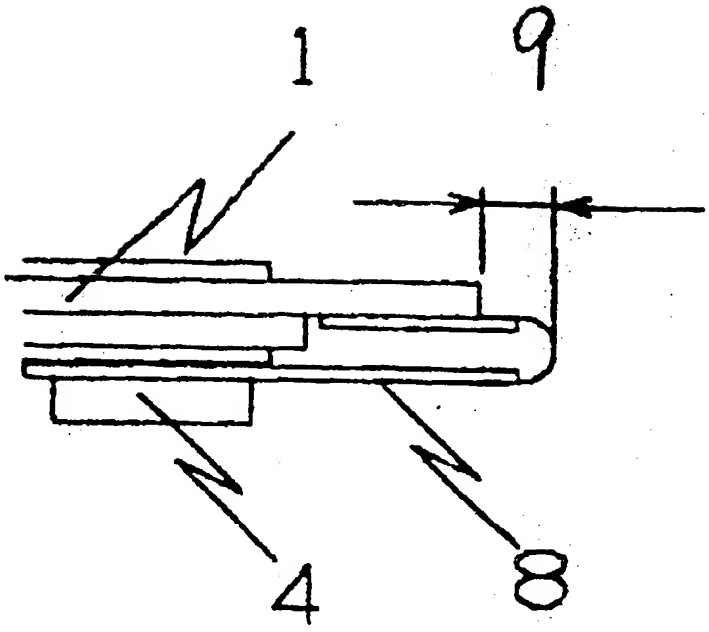


Fig. 4



prior art

Fig. 5

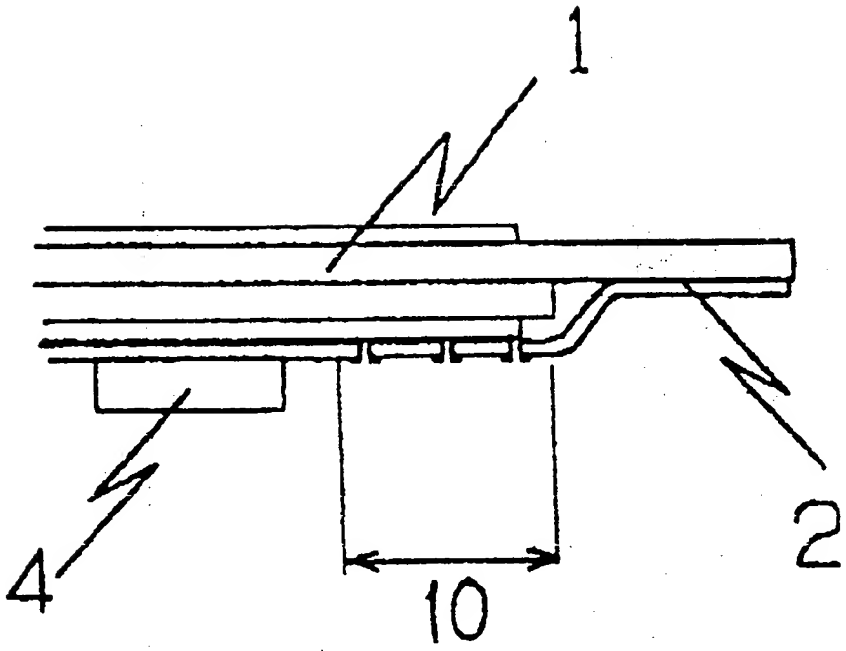


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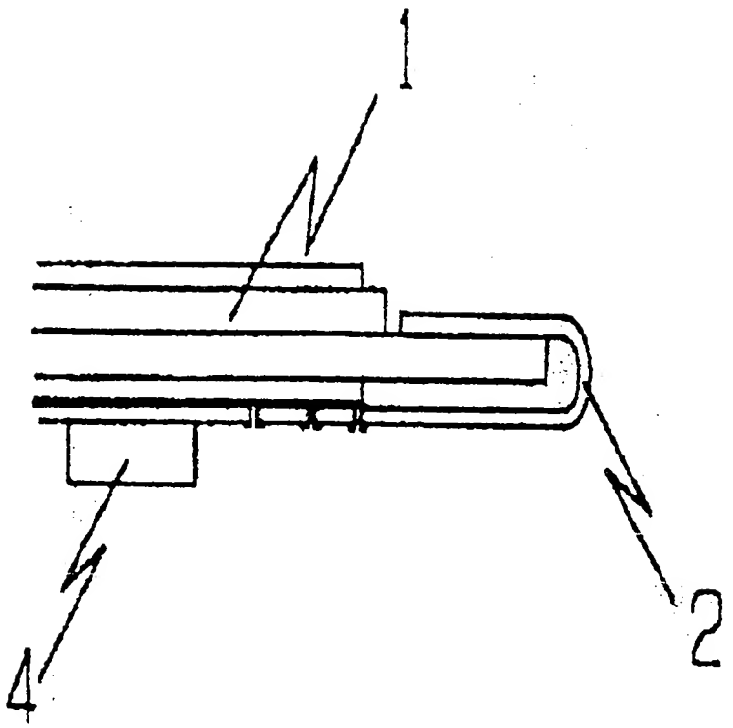
Fig. 6



prior art

Fig. 7

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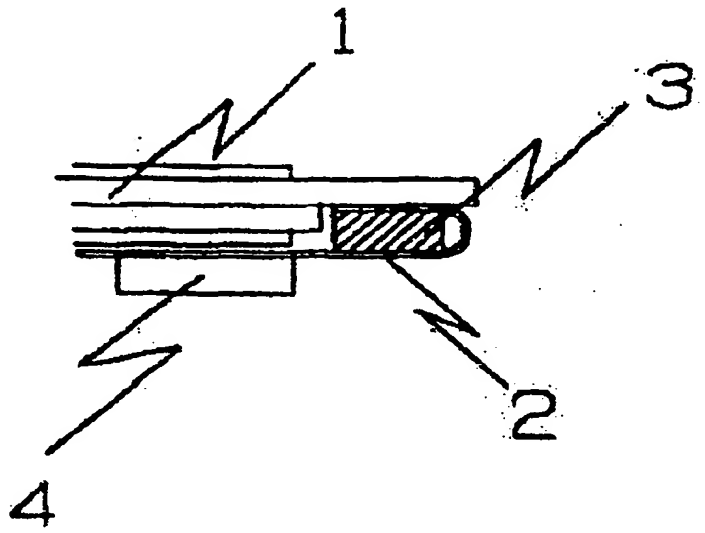

Fig. 1

EP 0 911 678 A3

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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 8666

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 5 606 440 A (KAWAGUCHI HISAO ET AL) 25 February 1997 (1997-02-25) * column 11, line 34 - line 51 * * column 13, line 35 - line 41 * * column 14, line 63 - column 15, line 3 * * figures 1B,4 *	1,2	G02F1/1333 G02F1/13
A	US 4 690 510 A (YAMAMOTO KUNIHIKO ET AL) 1 September 1987 (1987-09-01) * column 6, line 21 - line 57 * * figures 16-20 *	1	
P,A	US 5 737 053 A (YOSHIDA IKUE ET AL) 7 April 1998 (1998-04-07) * column 7, line 31 - line 55 * * figure 8 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) G02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	21 September 2000	Petitpierre, O

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